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Urban Development and Energy Access in Informal Settlements. A Review for Latin America and Africa

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Abstract

Focusing on Latin America and Africa, a review on energy access, efficient energy use, and energy efficiency of the built environment in informal settlements of developing countries is presented, providing information on energy issues such as access, consumption, distribution, services, end use, technologies, and energy efficiency. Information about the main patterns of energy use and consumption in slums is provided, and the main barriers that reduce access to modern (and more efficient) energy sources for dwellers are highlighted.

This review also reveals from one side that data on energy, and in particular energy efficiency, are missing or out-dated, as well as data and information on the interaction between energy distribution companies and slums' dwellers. Further investigations are now in progress in order to fill the gap. In particular, in cooperation with local stakeholders and utilities, workshops and surveys with interviews to people living in slums are being carried out.

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Keywords: informal settlements; energy access; energy consumption; Latin America; Africa.

1. Introduction

The impressive urban growth that we are witnessing in the last decades is essential for our future development. Cities are among the most important engines of development, concentrating in a relatively small area minds, cultures,

innovation, economies, and network of relationships. At the same time, cities also concentrate some of the worst characteristics of urbanization, such as inequalities and very poor living conditions in large peri-urban areas.

Slums and their dwellings may vary from simple shacks to more permanent structures, while access to basic services and infrastructure tends to be limited or badly deteriorated. As of today, slum dwellers, whose global number is estimated in about 1 billion, slightly less than one third of the global urban population.

Improving the living conditions in slums is a crucial topic also addressed by the sustainable development goals, and access to modern energy services (electricity, clean and safe cooking systems) plays a fundamental role in achieving these specific goals.

While the lack of modern cooking systems affects mainly health (indoor pollution due to biomass has a strong impact on women and children health) and family expenditure, lack of electricity access has a strong impact on education and on productive income-generating activities. For this reason, access to modern energy services (clean cooking and access to electricity) for slum dwellers is a crucial need for improving their quality of life and promoting the development of low income urban areas. Within this framework, slums electrification is a priority that still finds barriers that prevent a fruitful cooperation between utilities, slum dwellers, and local authorities [1, 2, 3]. In particular, among the barriers, connection fee and the inability to pay regularly are the most relevant and direct consequence of the informality of the settlements: people cannot enter in formal agreements, and cannot pay a regular bill because of irregular income. As a consequence of this, many families opt to pay a neighbor to share a meter or turn to unlicensed electricians and even local cartels that provide the service illegally. [4, 5, 6].

This mechanism damages both the utilities and the dwellers: utilities experience, together with significant insolvency rates, both technical and non-technical losses, while dwellers, both formal and informal suffer from voltage outages due to the irregular load produced by the illegal connection. Furthermore, because of a virtually free connection, electricity theft triggers inefficient habits and wasting.

On the other side, the fact that people often pay a fee to a middle-man and usually pays high prices for poor informal services is an evidence of the fact that there is a fraction of slum dwellers that may pay electricity in the formal market, but because of the above mentioned barriers cannot enter into a formal market. Illegal connections therefore represent the desire of the poor to have access to the benefits that electricity provides.

This paper is focused on a research aimed at providing information on a wide spectrum of issues in informal settlements related to energy such as access, consumption and distribution, energy services and end use, energy technologies, energy efficiency level of the built environment.

2. Research Methodology

An analysis of energy consumption and energy efficiency in informal settlements of developing countries was developed within a collaborative project among Enel Foundation, Politecnico di Milano and UN-Habitat. The project aims at providing information on a wide spectrum of issues related to energy such as access, consumption and distribution, energy services and end use, energy technologies, energy efficiency level of the built environment. Furthermore, it investigates aspects related to mode of use, price paid for energy, business models and best practices in informal settlements of Latin American and African cities. In particular, the role of utilities and policy makers in promoting low cost solutions and business models able to enhance energy access and energy efficiency thereby improving people's living conditions is investigated. The main research steps are reported in Figure 1.

3. Research Methodology

The desk research activity was focused on understanding the state of the research on energy and slums. In general, we found that for many countries such information is missing and, where present, data are old (2003-2007). This fact represents a further motivation in performing the activities described in the present paper.

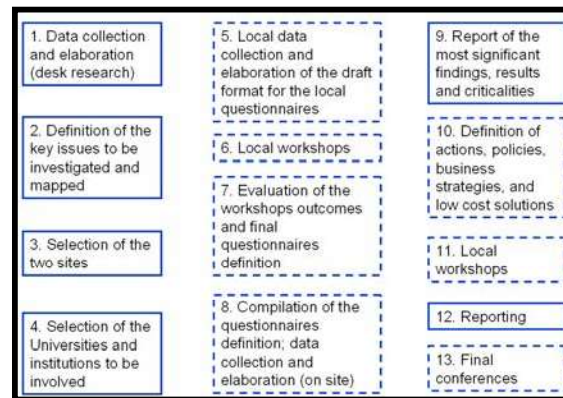


Fig 1. Research methodology scheme (dotted boxes indicate on site activities).

3.1. Energy and electricity access in Latin America

The Latin American and the Caribbean region (LAC) is one of the most urbanized in the world. Almost 80% of the population lives in cities and, after an initial relevant acceleration, the current evolution of urban populations tends to be limited to natural growth only. The number of cities in the region has increased 6 fold in 50 years. Half the urban population now lives in cities with less than 500,000 inhabitants and 14% in megacities [7,8]. Progress regarding access to water, sanitation and other services has increased the attractiveness of intermediate-size cities, which helps more balanced urban systems in these countries. The percentage of the population living in cities in Latin America is expected to rise reaching 86% by 2030 [9] and more than 90% by 2050 [10]. In Latin America 24% urban residents in the region live in slums and this number is expected to grow by half a million people every year, reaching 120 million by 2020 [11].

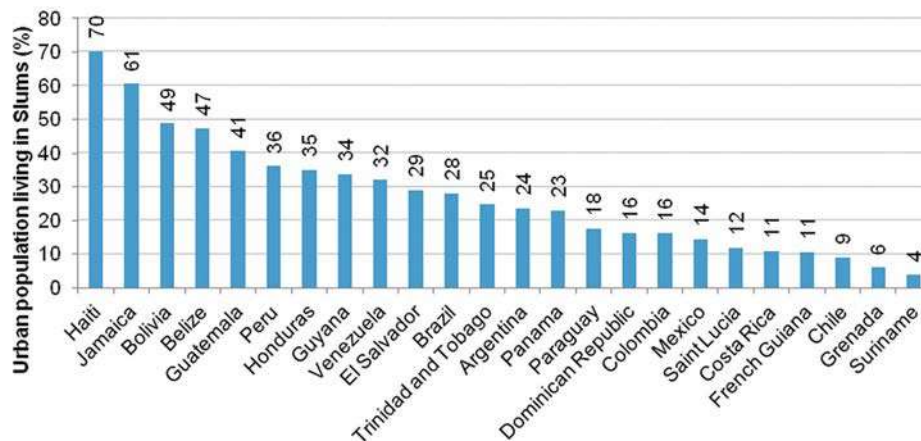


Fig. 2 – Percentage of urban population living in slums in the Latin America and Caribbean Region (elaborations on the basis of [7], [12]; data are from 2005 excluding Haiti, Bolivia, Guatemala, Peru, Brazil, Argentina, Dominican Republic, Colombia, Mexico, provided for 2007).

In Latin America government policy has promoted penetration of clean cooking fuels such as natural gas and LPG. This includes the development of an LPG delivery infrastructure in all regions, including rural regions, and subsidies to LPG users. The rest of population relies on wood, kerosene, candles, expensive disposable batteries and other

rudimentary, and often costlier, forms of energy [12]. As an example, Table 1 shows a comparison between Colombia and Peru in terms of type of fuel used in the households for cooking at urban and slum scale.

Table 1. Energy source used for cooking (percent households) (elaborations on the basis of [7]).

Energy source	Urban		Non slum		Slum	
	Colombia (2005)	Peru (2004)	Colombia (2005)	Peru (2004)	Colombia (2005)	Peru (2004)
Electricity	8.3	1.3	8.5	1.7	7.0	0.6
LPG, natural gas	85.6	73.1	87.1	83.2	79.2	55.5
Kerosene, other liquid fuel	1.0	11.6	0.5	8.3	3.1	17.4
Coal, lignite	0.2	1.8	0.1	0.8	0.4	3.6
Firewood, straw, dung, charcoal, other	2.5	9.5	1.3	3.2	7.8	20.5
Don't cook	2.4	2.6	2.4	2.8	2.4	2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 2. Percentage of population with access to electricity access in LAC (elaborations on the basis of [13, 14])

Country	Electricity access (%)	Country	Electricity access (%)
Argentina	96.3	Honduras	85.6
Bolivia	88.2	Mexico	99.2
Brazil	99.5	Nicaragua	72.5
Chile	99.6	Panama	89.1
Colombia	97.0	Paraguay	98.5
Costa Rica	99.0	Peru	90.8
Ecuador	94.0	Uruguay	99.1
El Salvador	92.0	Venezuela	99.7
Guatemala	84.6	Average	93.4

Among the South American countries, Peru has the second (after Bolivia) lowest rates of electricity access.

From a detailed picture of electricity access in LAC countries, it has been observed that there is a difference between the whole country figures and those related to informal settlement, where electricity connection is available for the 84.7% of dwellers [9]. Statistics show that between 1970 and 2006 per capita yearly average energy consumption has quadrupled (from 427 to 1,688 kWh) [7]. In Peru the monthly per capita average electricity consumption is about 30 kWh in rural areas and 100 kWh in urban areas [13]. Data on electricity access, however, in Latin America countries can be misleading if not complemented with the reliability of the supply. In 2005, the average number of outages per subscriber was 12.5, while duration of outages per subscriber was 16.5 hours [14].

3.2. Energy and electricity access in Africa

In 2008, Africa still had only 39.1% of its total population living in cities [15], making it the least urbanized region in the world. African urban populations are also highly unevenly distributed over the continent's sub-regions, ranging from a 22.7% urbanization rate in East Africa to 57.3% in the Southern Africa region.

Furthermore, Africa's urban slum populations is still growing, and in some of the fast-growing African cities almost all of the current urban spatial growth is the result of slum and informal settlements proliferation.

It is also interesting that most urban growth in Africa now takes place in secondary and tertiary settlements (the towns with less than 500,000 inhabitants) rather than in the largest cities. This is an even more noteworthy

phenomenon given that the bulk of Africa's urban transition, though yet to come, is only a generation away. By 2030 the majority of Africans will be urban residents, and the majority of them are expected to live in slums.

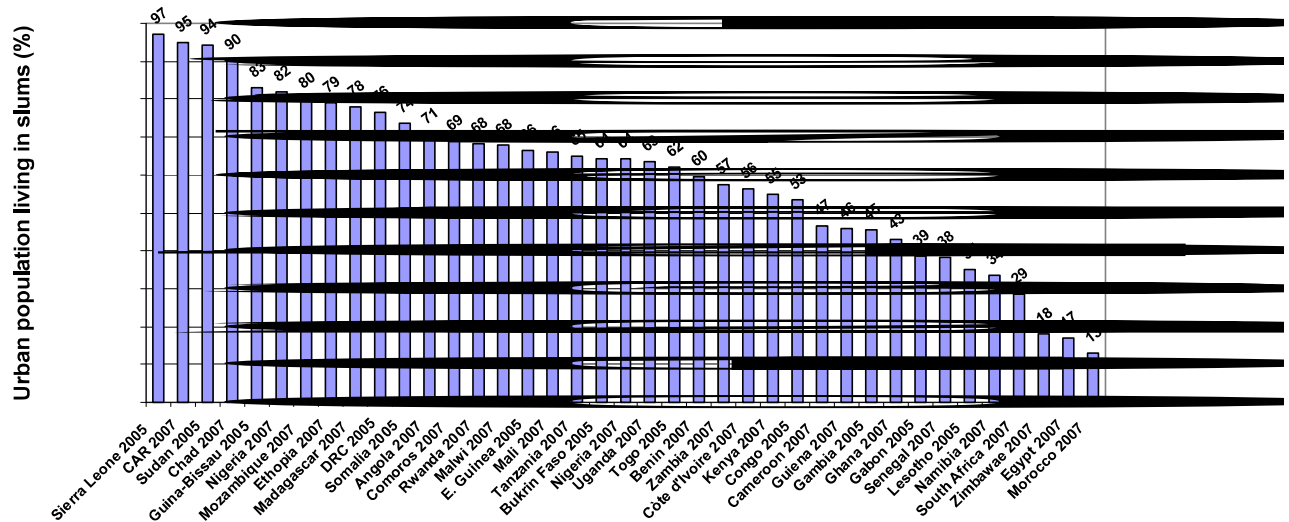


Fig. 3. Percentage of urban population living in slums in the Africa (elaborations on the basis of [10, 15]).

In Africa, access to modern energy for household cooking is very limited, with unsustainably large and growing population directly relying on biomass, especially in sub-Saharan Africa. Regarding electricity, access is about 30% but with significant disparity between urban (89%) and rural (46%) areas [16].

Rates in the Northern African countries, instead, are closer to those of developed countries, with 97% in Morocco, 99% in Algeria and 100% in Tunisia, Egypt and Libya. In many African countries, especially those in sub-Saharan region, low electrification rates are compounded by very low levels of electricity consumption implying very limited use of this energy service. It has been estimated [17] that basic modern energy needs can be satisfied with 50-100 kWh/person/year of electricity for lighting, health, education, communication and community services and with 50-100 koe (600-1200 kWh) of modern fuel (or traditional fuel used in improved cook stoves) for cooking and heating water). Data on electricity access, however, in African countries can be misleading if not complemented with the reliability of the supply, as shown in Fig. 4 [18], where consequent impact of outages on electricity company sales is also shown.

4. Local surveys

The research adopts a participative approach that involves local communities and relevant stakeholders operating in slums. In particular, data collection is being carried out by surveying slum dwellers by means of a multi-tier questionnaire [19], drafted in agreement with the ESMAP programme of the World Bank. The questionnaire covers several aspects of energy use and energy efficiency in slums, ranging from purely architectonic aspects to energy use patterns, and relationship with utilities and informal energy providers. Furthermore, the questionnaire is also improved by means of "consultative" workshops that involved the slum communities and local stakeholders (e.g. policy makers, experts and representatives from utilities and Universities). Data on questionnaire will be elaborated as soon as the activity will be concluded. Results will be shared with local stakeholders and communities, while educational activities on energy use and energy efficiency will be implemented and devoted to slum dwellers.

Case studies have been selected in Lima (representative of Latin America) and Lagos (representative of Africa). In both cities, consultative workshops have been organized and local population has been involved.

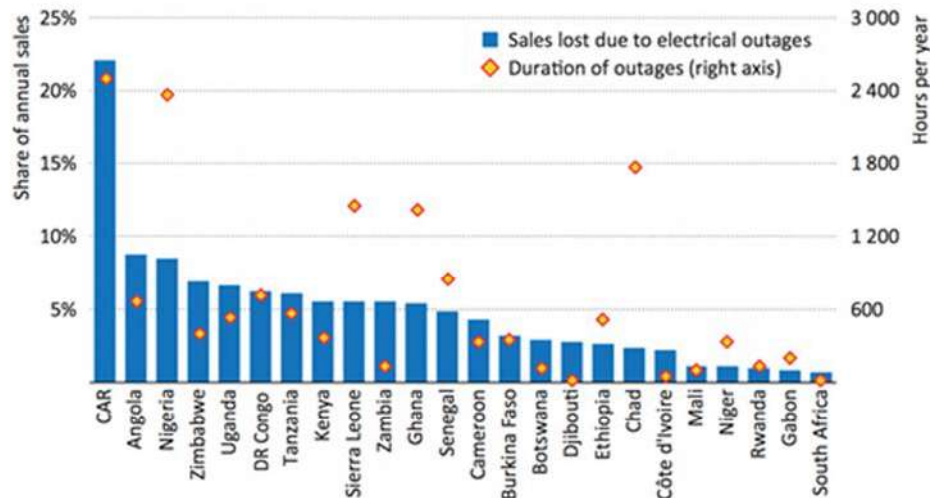


Fig. 4: Duration of electrical outages and impact on business sales in selected countries.

5. Conclusions

From the desk research conducted in the present work, it has been found that compared to Latin America, in Sub Saharan Africa access to modern energy services is far more critical.

Kerosene is generally the most used fuel for cooking (with all the safety and cost problems deriving), followed by biomass (with the health problems deriving). The major part of slum dwellers lays in the lower part of the energy ladder. Also electricity access statistics are far away from those of Latin America, and the technical and non-technical barriers are combined: not only the problem of illegal connections and theft is present, but also the grid often does not reach the neighborhood. Exceptions to this general rule are Dakar and Lagos, where the energy access is estimated above 95%. In comparison with Latin America, also the quality of service is a significant issue that reaches very high values in number and duration in all cities, especially in Lagos.

Thus, African cities are only at the beginning of the path leading to modern energy use among the poor, exacerbated by the fact that the percentage and the absolute number of slum dwellers is far higher than in Latin America. Because of the scarce diffusion of LPG as cooking energy source, a special challenge has to be faced in Africa about the use of more efficient cooking devices, not only more efficient electric devices.

Thermal comfort conditions are generally very poor in the slum's dwellings, where the hot climate is exacerbated by inappropriate construction materials (as iron sheets used for roofing) and by lack of ventilation. Growing the availability of affordable electricity, it can be expected growing consumption at least for the use of fans, or of low cost and inefficient air conditioners. The issue of the electric appliances efficiency is not yet an issue because of their very limited diffusion due to the poverty of slum dwellers, but even a slight improvement of their conditions, as experienced in Latin America, will make this issue critical and needing to be faced as early as possible.

In Latin American slums, the main challenge is the affordability of the service and the low efficiency of the electric appliances, leading to higher consumption and costs.

The different situation is mainly due to a different approach both from utilities and policy makers: while in Africa slum dwellers – being illegal – are generally kept out of any plan for extending the basic services, in Latin America the approach has been more aimed to the legalisation of the slum dwellers, providing them energy services like

subsidized electricity and LPG for the poorest, thus promoting actions and policies for the development of disadvantaged urban areas. Example of this can be found in the initiatives developed in Brasil by the local government in cooperation with the electric utility both in Rio de Janeiro and in Fortaleza [20].

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